Fiscal Year:	FY 2022	**Task Last Updated:**	FY 09/29/2022
PI Name:	Norcross, Jason M.S.		
Project Title:	Validation of Fitness for Duty Standards Using Pre- and Post-Flight Capsule Egress and Suited Functional Performance Tasks in Simulated Reduced Gravity		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:			
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **HHC**:Human Health Countermeasures		
Human Research Program Risks:	(1) **EVA**:Risk of Injury and Compromised Performance Due to EVA Operations (2) **Sensorimotor**:Risk of Altered Sensorimotor/Vestibular Function Impacting Critical Mission Tasks		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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City:	Houston	**State:**	TX
Zip Code:	77058-3711	**Congressional District:**	36
Comments:			
Project Type:	FLIGHT	**Solicitation / Funding Source:**	2017-2018 HERO 80JSC017N0001-BPBA Topics in Biological, Physiological, and Behavioral Adaptations to Spaceflight. Appendix C
Start Date:	01/30/2019	**End Date:**	12/01/2027
No. of Post Docs:		**No. of PhD Degrees:**	
No. of PhD Candidates:		**No. of Master' Degrees:**	
No. of Master's Candidates:		**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:		**Monitoring Center:**	NASA JSC
Contact Monitor:	Stenger, Michael	**Contact Phone:**	281-483-1311
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Flight Program:			
Flight Assignment:	NOTE: End date changed to 12/1/2027 per HHC element/JSC (Ed., 12/14/20)		
Key Personnel Changes/Previous PI:	Several changes in personnel have been made since the inception of this project, including the departure of several Co-Investigators. Dr. Millard Reschke retired. Dr. Marissa Rosenberg left KBR for another position. Dr. Jeffrey Ryder has changed roles within KBR and is no longer supporting this project. In place of Drs. Reschke and Rosenberg, we added Dr. Brian Peters from the NASA Johnson Space Center (JSC) Neurosciences Laboratory as a subject matter expert in Neuroscience; and in place of Dr. Rosenberg's deputy PI and study coordinator role, Dr. Taylor Schlotman of the JSC H-3PO Laboratory has been added. Dr. Ryder's role has been taken over by Dr. Eric Rivas of H-3PO. Dr. Lauren Cox has been added as part of the research and data test team.		

COI Name (Institution):	Abercromby, Andrew Ph.D. (NASA Johnson Space Center) Young, Millennia Ph.D. (NASA Johnson Space Center) Schlotman, Taylor (KBR) Peters, Brian (KBR) Cox, Lauren (JES Tech) Rivas, Eric (KBR)
Grant/Contract No.:	Internal Project
Performance Goal No.:	
Performance Goal Text:	
Task Description:	Rigorous adherence to available inflight countermeasures has effectively mitigated losses or maintained muscle strength and aerobic capacity in some returning long-duration International Space Station (ISS) crewmembers; however, all astronauts demonstrate significant decrements in functional performance upon return to a gravity environment. These losses in functional performance can be largely attributed to neurovestibular / sensorimotor deficits that can take days or weeks from which to recover and for which there is no current operational countermeasure. Although these losses are tolerable for current land-based returns to Earth, where ground personnel can quickly support the crew at the landing site, this will not be the case for future off-nominal water-based Orion landings or for nominal Mars surface landings, both of which will require crewmembers to be capable of egressing their landing vehicle unassisted. Quantification of astronauts' post-landing functional capacity including ability to perform an unassisted capsule egress and critical planetary extravehicular activity (EVA) tasks is necessary to design concepts of operation for Moon and Mars exploration mission systems and ultimately to promote exploration mission success. These results can then be reviewed in combination with other pre-flight, in-flight, and post-landing measures and determinants of health and performance (e.g., sleep, nutrition, exercise) to help develop and select necessary countermeasures capable of protecting all crewmembers or to identify characteristics (both behavioral and inherent) that might allow for selection of crew dependent on mission objectives. Data collected in this proposal will provide unique data on unassisted capsule egress while wearing an unpressurized launch, entry, abort (LEA) suit in Earth's gravity and on EVA-relevant functional task performance by testing astronauts shortly after return to Earth while suited and pressurized in a simulated reduced gravity analog. The research product will be a temporal profile of unassisted capsule egress and planetary EVA task performance pre-flight and at multiple post-landing intervals, the timing of which will be determined based on post-landing logistics and coordination with other investigations. Data will be collected for spaceflight missions ranging from 2 months, 6 months, and up to 1 year in duration. Results of the proposed study will be used in combination with subsequent definition and design of exploration mission systems and operations concepts to define data-based Fitness for Duty standards.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	The core focus of this study is to facilitate safe exploration of Mars and return back to Earth, which albeit has limited direct impact to the people on Earth, but to the extent that space exploration is for the good of all humanity, this study will facilitate more successful missions to Mars.
Task Progress:	The transition between gravity environments will involve one of the most complex high risk phases of any mission. For example, physiological deconditioning adaptations that occur in microgravity, coupled with the stressors of re-entry into a partial gravity environments, will increase risks to crew as a result of reduced functional capacity, even with rigorous adherence to inflight countermeasures. Quantification of the astronauts' post-landing functional performance is necessary to design a Concept of Operations (ConOps) for exploration missions. Specifically, these two high-risk scenarios may be required to be performed soon after gravity transitions: • Nominal and/or emergency unassisted capsule egress task after return to Earth • Planetary extravehicular activity (EVA) soon after landing on Mars or the Moon This study is broken down into two phases. Phase 1: A feasibility study that will assess the overall feasibility and demonstrate the capability to do these tasks shortly after landing, and Phase 2: the full Egress Fitness study, which is part of the Complement of Integrated Protocols for Human Research (CIPHER). This study uses a task-based approach to characterize functional performance of these high-risk scenarios in long-duration International Space Statino (ISS) crewmembers before flight and shortly after return to Earth. Prior to any testing, each astronaut subject completes a suit fit check to ensure adequate sizing, and a mobility assessment to confirm completion of the EVA tasks. Pilot Egress Fitness pre-flight and post-flight testing includes an Earth-based emergency egress out of a functional capsule mockup, and a short Mars gravity EVA simulation including suit donning, hatch egress, ladder descent, task board cable operations, baggage transfer over sand/rocky regolith, alignment with a rear entry port, and suit egress. Pre-flight testing will occur at any timepoint prior to flight. Post-flight assessment is much more critical with the capsule egress test that will occur 1-4 hours after landing and the planetary EVA approximately 18-36 hours after landing. The CIPHER study will incorporate additional pre-flight sessions, longer EVA tasks that include traverse and geology sampling, and post-flight sessions on R+1, 4, and 8 to characterize the timeframe of recovery. Data collected for both tasks include task completion time, photo, and video. The EVA portion also includes collection of metabolic and heart rate. Pilot Egress Fitness study has completed both baseline and post-flight testing on four astronaut subjects, with all four able to complete post-flight EVA testing and three able to complete post-flight capsule egress testing. Preliminary results observe individual physiological variations, which were to be expected, but also suggest the need to carefully track the timeline from undock to landing to testing. Furthermore, some task performance instructions and equipment may need to be adjusted to ensure results are primarily physiological. These and other lessons learned will be addressed with minor protocol changes in the full CIPHER Egress Fitness study.
Bibliography Type:	Description: (Last Updated: 02/21/2024)